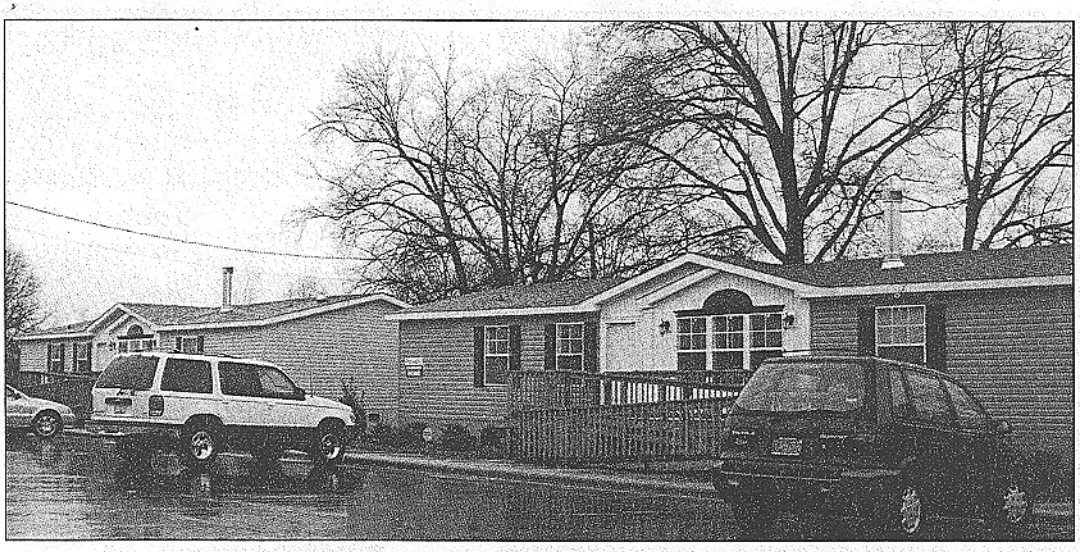


The HUD-Code home CERT test house, far left, and the virtually identical base house, on the right are being used in testing to establish energy savings techniques and practices by the North Carolina Agricultural and Technical University team.

Up to 50% Energy Savings Proven Possible:

University Studies Energy Efficiencies in Manufactured Housing

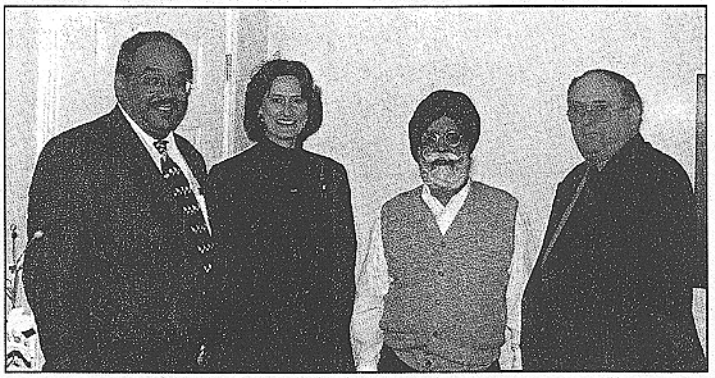
By Paul Sedan

GREENSBORO, NC—Using two, identical, double-section HUD-Code units, professors and students from North Carolina Agricultural and Technical University (NCA & T) in Greensboro, NC, have begun studying the impact specific energy-saving features may have on today's manufactured housing.

The study group is under the aegis of the Manufactured Housing Research Initiative, part of NCA & T's Center for Energy Research and Technology (CERT). CERT bills itself as, "A leader and focal point for building-related energy education, research and technology transfer in North Carolina and the Southeastern United States." Other CERT groups include the Energy Audit & MV [Measurement Verification] Team, the Fuel Cell Team, the Renewable Energy Team, and Technology Transfer.

The energy study is also a participant in the U.S. Department of Energy's Building America Industrialized Housing Partnership, which is being conducted through the Florida Solar Energy Center. The two houses are just two of many nationwide being monitored for energy usage as part of the DOE's effort.

The project began in early 2000, when CERT contracted with Palm Harbor Homes to build two identical units in their Silver City, NC plant. Both units have the same floor plan with three bedrooms and two full baths. Both have the same siding and shingles. Interior furnishings are about as alike as you can get. But here the similarity ends.

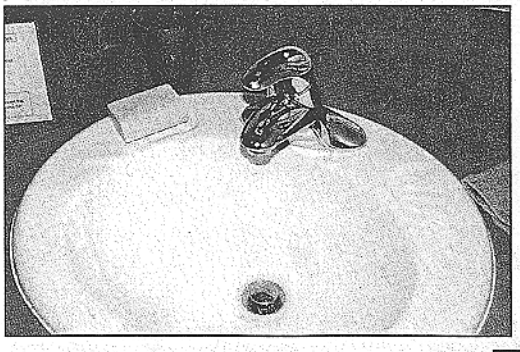


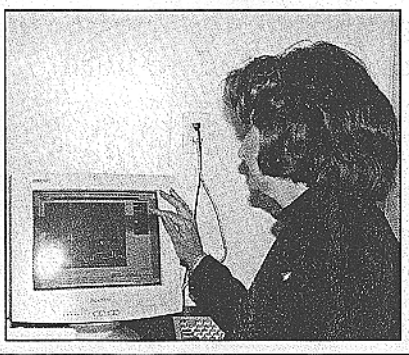
CERT Team (L to R): Bob Powell, assistant professor of architecture; Dr. Carolyn Turner, professor, housing research; Dr. Harmohindar Singh, director, CERT, and Bob Pyle, professor, department of construction management.

Actually the research staff had to convince Palm Harbor Homes to take two steps back when they asked for a unit with no energy efficiency features. According to Bert Kessler, vice president of design and engineering, Palm Harbor has been incorporating many of the things NCA & T wanted to do for some time. In fact the manufacturer was the first HUD-Code builder to produce DOE/EPA Energy Star-compliant homes. As a result they received EPA's Manufactured Home Manufacturer of the Year Award in 1998.

What Palm Harbor did do was build one unit with just the basics: R-11 insulation in the floor and walls, R-20 in the ceiling, single-pane windows with storm windows, storm door on the front door only, forced air heating and cooling with electric furnace and central air, electric 40-gallon water heater with double element, standard electric lighting, and fiberglass sill sealer at the marriage wall.

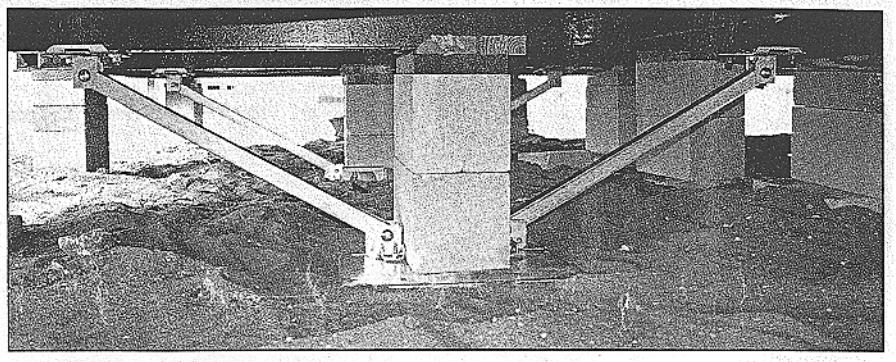
The test unit got energy tweaked with R-22 insulation in the floor, R-13 in the walls, R-33 in the ceiling, low-E thermopane windows, storm doors on all exterior doors, forced air heating and cooling with a SEER-12 heat pump, solar water heater system with 67-gallon electric tank with single element, a solar tube skylight in one bathroom for lighting, and a special foam gasket seal at the marriage wall. Another important feature is the air-tight duct system. The combination of these features allowed downsizing of the AC in the energy unit by one ton





Far left: The lever-operated faucet is one of a host of requirements for universal design housing which allow use without requiring special skill, height, strength, or other capabilities which might hinder some residents.

Left: Dr. Carolyn Turner observes the test monitor readout, which is checked daily to evaluate energy effficiencies.



Right: CERT is also evaluating HUD-Code housing tie-down methods, comparing Tie-Down Engineering's Vector Dynamics Foundation System with conventional setup. The Vector system uses physics to redirect stress under wind load.

In addition to making their test house more energy efficient, NCA & T also added universal design features. This concept intends to simplify interior design by making housing more usable by everyone regardless of his or her level of ability or disability. These features include wider interior door openings (36") to the master bedroom and bath, lever handles on all faucets, knee space under all countertops with sinks, lever door handles, light switches at 44 to 48" heights, variable height work surfaces in the kitchen, grab bars in tubs and showers, and a 1:20 entry ramp at the front door.

Some months into the program, NCA & T is finding that the energy upgrades are having a significant effect. The staff uses sophisticated monitoring equipment to measure the interplay in determining energy consumption. This includes daily measuring of the wind velocity, outside temperature and relative humidity, indoor temperature and relative humidity and solar radiation. Comparisons of both units' energy consumption are showing that the test house is using about 50% less heating energy than the base house -- confirming what the CERT crew hoped to see.

In addition to the energy and universal design ideas, CERT is demonstrating tie-down methods, using Tie Down Engineering's Vector Dynamics Foundation System for the test unit and standard HUD-Code anchor and strap with special swivel frame connectors for the base unit. The Vector Dynamics system, which has been on the market for over three years, uses the tension-compression model to help create a stronger way to anchor the unit to the ground. Parts include cleated Vector Pads, steel tension brackets, and standard HUD-Code metal strapping. Basically, the Vector System uses the building structure to transfer pier loads into the cleated foundation pads.

The wind loads are transferred from the wind side of the home through diagonal cross ties to the opposite side pads. As wind loads increase, opposite side pier forces also increase. This increases the vector pads resistance to horizontal movement. In other words, the Vector system uses 'physics,' not ground anchors, to lock the home to the ground.

Although a relatively new product, Vector Dynamics is now the preferred method for all Palm Harbor's and Fleetwood Homes installations and is approved by all the other HUD-Code manufacturers as an alternative to traditional ground anchors. Palm Home's Kessler is bullish on Tie Down's Vector System as well. "We had some initial participation in the development of it," he says. "We did some testing early on with our product in Florida and we really, really liked the results of that system over conventional anchoring. In fact, last year I incorporated that into our installation manual as the recommended way to install the home."

Dr. Carolyn Turner, professor for housing research in NCA & T's Department of Human Environment & Family Sciences, sees their research initiative as having an important impact.

"It helps students see how to apply scientific research to affordable housing alternatives as well as to see the advantages of universal design. And it also helps both students and faculty have a laboratory to help us be involved in energy-related research."

Turner believes that the manufactured housing community, a major player in the state's economy, can benefit from taking CERT's research findings and applying them to their product lines. And, she notes, the buying public also wins because they'll end up with energy efficient options that can measurably cut monthly energy bills.

What's the bottom line? Dr. Harmohindar Singh, head of NCA & T's CERT, says that they estimate the extra costs, including a passive solar water heater, adds about $6,000 to $8,000 dollars to the base price of the unit. But with a 50% savings on energy bills, he says the homeowner's return on investment could be realized in a few years, maybe sooner, given the current rise in energy costs.

Those interested in a daily view of CERT's test house can log on to www.infomonitors.com/ncatu. For further information about NCA & T and CERT, go to www.ncat.edu/~cert.

For information on Tie Down Engineering circle Reader Service No. 88.

For information on Palm Harbor Homes circle Reader Service 89.